

**CHARACTERISTICS OF THE *LOYOLA* NAVÁS MALE
(NEUROPTERA: CHRYSOPIDAE: APOCHRYSINAE)**

CATHERINE A. TAUBER, GILBERTO S. ALBUQUERQUE, AND MAURICE J. TAUBER

(CAT, MJT) Department of Entomology, Comstock Hall, Cornell University, Ithaca, NY 14853-0901 (e-mail: mjt4@cornell.edu); (GSA) Laboratório de Proteção de Plantas, CCTA, Universidade Estadual do Norte Fluminense, Campos dos Goytacazes, Rio de Janeiro, Brazil 28013-600 (e-mail: gsa@uenf.br)

Abstract.—The only known male specimen of the rare New World genus *Loyola* Navás has genitalic characteristics that are generally consistent with those described for its subfamily, Apochrysinæ. The genitalic characters are also consistent with the placement of the genus in the *Joguina* clade of Apochrysinæ. Our specimen of *Loyola croesus* (Gerstaecker), one of three species in the genus, has several distinguishing genitalic features; whether these features typify the genus *Loyola* or only *L. croesus*, is unknown.

Key Words: Chrysopidae, *Loyola*, *Joguina* clade, Apochrysinæ, green lacewings

Apochrysinæ is a small, largely tropical subfamily of strikingly handsome, but rarely encountered green lacewings. Adults have slender, graceful bodies and broad, delicate wings that are often elaborately marked or have densely reticulate venation. For some genera only one sex is known, and with one exception, *Apochrysa* (= *Nacaura*) *matsumurae* (Okamoto) (Tsukaguchi 1995), the biological characteristics and immature stages of all members of the subfamily are unknown.

In a recent phylogenetic study, Winterton and Brooks (2002) confirmed the monophyly of the subfamily and reduced the 13 previously recognized genera to six. Of these, three occur in the New World, specifically, Central and South America. They are *Domenechus* Navás (known only from the New World; two species—one each from Guatemala and Brazil), *Joguina* Navás (five species in total: three from the Orient, two from the New World—one each from Guatemala and South America), and *Loyola* Navás (known only from three New World

species: two from Brazil, the third from Mexico, Nicaragua, Costa Rica, Panamá, Venezuela, and Brazil; previously known only from females). Together with the Oriental genus, *Nobilinus* Navás, these three genera comprise the *Joguina* clade of Apochrysinæ (Winterton and Brooks 2002).

The male terminalia of Apochrysinæ are reduced and vary only in minor respects among taxa. Nevertheless, they provide some characters that are useful in identifying species and in helping to discern phylogenetic relationships, both within Apochrysinæ and between Apochrysinæ and other chrysopid taxa (Winterton and Brooks 2002). Thus, the lack of information on males in the genus *Loyola* left a distinct gap in the knowledge of New World Chrysopidae.

During a recent field trip in the Mata Atlântica of the State of Rio de Janeiro, Brazil, one of us (GSA) collected a male of *Loyola croesus* (Gerstaecker). Our short note here describes the external and internal

characteristics of the abdomen of this specimen. We hope to acquire additional males and females of this rare species and to rear and describe the immatures.

MATERIALS AND METHODS

The specimen, which was teneral when collected, was taken to the laboratory where it matured for ten days on a diet of autolyzed yeast, fructose, and honey (1:1:1 mixture by volume), photoperiod of LD 16:8, temperature of $24 \pm 1^\circ\text{C}$. It was then frozen and pinned; subsequently, the abdomen was removed (at segment 3), cleared in a warm solution of 10% KOH, rinsed, stained with Chlorazol black, and preserved in glycerin. The specimen is deposited in the insect collection of the Universidade Estadual do Norte Fluminense, Campos dos Goytacazes, RJ, Brazil.

RESULTS AND DISCUSSION

Loyola croesus (Gerstaecker)

Collection record.—The specimen was taken in a small fragment of secondary forest at Fazenda Carrapeta ($22^\circ 10' \text{S}$, $41^\circ 52' \text{W}$), Conceição de Macabu, Rio de Janeiro State, 200 m altitude, November 5, 2002. G. S. Albuquerque and Ederaldo A. Silva, collectors. Collection of the teneral specimen occurred on the wing, in the forest on a rainy day.

Description of male abdomen.—Abdomen thin from segment 1 through 6, swollen apically from segment 7 (Figs. 1A, B). Dorsum and sides green with tergites yellow. Sternites 1 to 3 (S1–3) yellow; S4 yellow anteriorly, brown posteriorly; S5 brown; S6 to 8+9 yellow. Callus cerci yellow.

Segments 4 to terminus (cleared and stained): Integument (sclerites and intersclerotic membrane) with moderately dense covering of microsetae and more sparsely scattered, straight setae; without microtholi. Spiracles positioned mesally in intersegmental membrane, not enlarged or elaborate, with shallow, bilobed atria.

Tergites 3 through 6 (T3–6) well defined, but without dark margins, largely quadrate in lateral view. Anterior of T7 (lateral view) approximately 1.3 times depth posteriorly. T8 short; anterior margin (lateral view) deeper than posterior margin of T7. T9 very weakly sclerotized, probably not fused with ectoprocts; apodemes not distinguished. Ectoprocts fused dorsally via a broad band, without dorsal invagination, rounded basally and apically, very near each other posteroventrally. Callus cerci oval; ~35–40 relatively short trichobothria, not extending much beyond margins of callus cerci. Sternites through S7 quadrate in ventral, lateral views; margins well defined, darkly stained; intersegmental membranes between S3, S4, and S5 very short; connections between S5, S6, S7 and S8 distinctly membranous. S8+9 fused, tapering and rounded distally, without lateral processes.

Genitalia well sclerotized. Tignum, gonapsis absent. Gonarcus (Fig. 1C) broadly arcuate, dorsoventrally flattened, bearing a pair of upturned entoprocesses laterally. Mediuncus [= arcessus of Winterton and Brooks (2000)] well sclerotized, broad and bulbous basally, tapering to two rounded lobes apically, apparently with a trough dorsally, eight pairs of short gonosetae apically. Hypandrium internum (Fig. 1D) arrow-shaped, with pointed tip apically and raised, rounded keel mesally; comes small, curved upward.

Abdominal characteristics.—In their cladistic analysis of the Apochrysinæ, Winterton and Brooks (2002) used six characters from the male abdomen. Here we code *L. croesus* for each and discuss its relationship with other genera in Apochrysinæ (see Table 1). The numbered characters refer to Winterton and Brooks' characters:

30. Male Ectoprocts. (0) Separated dorsally. (1) Fused dorsally.

With the exception of the genus *Joguina* (= *Joguina* + *Lainius*), the ectoprocts of males in Apochrysinæ species are typically joined. In *L. croesus*, they are connected via a broad, sclerotized band (1).

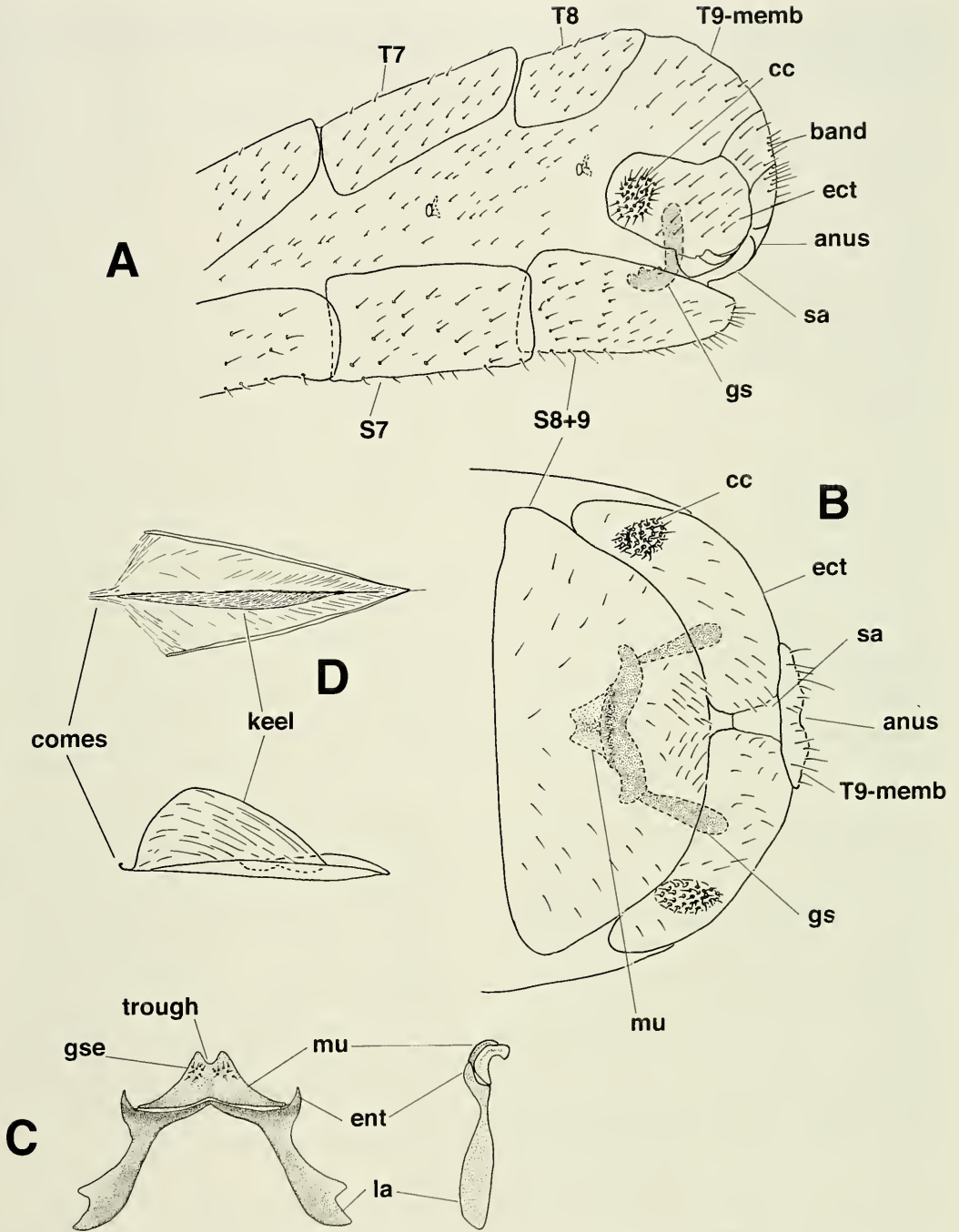


Fig. 1. *Loyola croesus*, male abdomen. A, Terminal segments, lateral view. B, Terminal segments, ventral view. C, Gonarcus: left, dorsal view; right, lateral view. D, Hypandrium internum: upper, dorsal view; lower, lateral view. cc, callus cerci; ect, ectoproct; ent, entoprocessus; gs, gonarcus; gse, gonosetae; la, lateral arms of gonarcus; mu, mediuncus (= arcessus of Winterton and Brooks 2002); S7, seventh sternite; S8+9, fused eighth and ninth sternites; sa, subanale; T7, seventh tergite; T8, eighth tergite; T9-memb, very weakly sclerotized or membranous ninth tergite.

Table 1. Male abdominal characters among exemplars of Apochrysinæ (Chrysopidae). Coding follows Winterton and Brooks (2002). Data for *Loyola croesus* are added to those published by Winterton and Brooks (2002) and Tjeder (1966) * for the other species.

Species	Winterton and Brooks Character No.					
	30	31	32	33	34	35
<i>Apochrysa</i>						
<i>montrouzieri</i> (Girard)	1	0	0	0	0	0
<i>lutea</i> (Walker)	1	0	0	0	0	0
<i>voeltzkowi</i> (Weele)	1	0	0	0	0	0
<i>matsumurae</i> (Okamoto)	1	1	0	1	0	1
<i>wagneri</i> (Hölzel)	1	1	0	0	?	1
<i>retivenosa</i> (Winterton)	1	0	0	0	0	1
* <i>africana</i> (Kimmins)	1	0/1	1	0	0	0
* <i>leptalea</i> (Rambur)	1	0	0	0	1	1
<i>Domenechus</i>						
<i>mirificus</i> (Gerstaecker)	1	1	0	0	0	1
<i>Joguina</i>						
<i>nicobarica</i> (Brauer)	0	1	0	0	0	1
<i>constellatus</i> (Navás)	0	1	0	0	0	0
<i>Loyola</i>						
<i>beata</i> (Walker)	?	?	?	?	?	?
<i>croesus</i> (Gerstaecker)	1	1	1	0	0	1
<i>Nobilinus</i>						
<i>albarda insignitus</i> (Navás)	1	0	0	0	0	0
<i>Nothancyla</i>						
<i>verreauxi</i> (Navás)	1	0	1	0	1	0

31. Male Ectoprocts and T9. (0) Fused. (1) Separate.

In *L. croesus*, T9 is very weakly sclerotized and appears to be separate from the ectoprocts (1). However, the condition is not entirely clear on our specimen.

A character state of male ectoprocts separate from T9 is consistent with that in other members of the *Joguina* clade. But, it is noteworthy that the trait can vary among species within a genus [as in *Apochrysa* (Winterton and Brooks 2002)], and we suspect that it may vary with maturation. Thus, re-evaluation across all species within the subfamily is warranted.

32. Entoprocesses. (0) Absent. (1) Present.

Distinct, upturned entoprocesses are present on the *L. croesus* gonarcus (1). The other Apochrysinæ genera that are reported to have entoprocesses are *Nothancyla* and

Apochrysa, neither of which is in the *Joguina* clade. In *Nothancyla* (= *Anapochrysa*) *verreauxi* Navás the entoprocesses are well defined and shaped like those in *L. croesus*, but they are less prominent (Tsu-kaguchi 1995, fig. 106i; mentioned in Winterton and Brooks 2002; not visible in sketch by New, 1980, p. 88). In *Apochrysa africana* (Kimmins) the entoprocesses are much smaller (Tjeder 1966, fig. 1861) than in *L. croesus*.

33. Gonarcus. (0) Arcuate. (1) Transverse.

Within the Chrysopidae, an arcuate gonarcus is plesiomorphic. Except for *Apochrysa matsumurae* (Okamoto) (Winterton and Brooks 2002), the condition holds for all known Apochrysinæ, now including *Loyola* (0).

34. Mediuncus (= *Arcessus*) Shape. (0) Short, broad. (1) Elongate, narrow.

As in all other studied species of Apochrysinæ (except *N. verreauxi*), the mediuncus of *L. croesus* is relatively short, broadly based and tapered apically (0).

35. Gonosetae on Arcessus. (0) Absent. (1) Present.

Eight pairs of gonosetae occur on the *L. croesus* arcessus. In this respect, *L. croesus* resembles *Domenechus*, several *Apochrysa* species [but not *A. africana* (Kimmins), *A. lutea* (Walker), *A. montrouzieri* (Girard) or *A. voeltzkowi* (Weele)], and *Joguina nicobarica* (Brauer) [but not *Joguina constellus* (Navás)] (Tjeder 1966, Tsukaguchi 1995, Winterton 1995, Winterton and Brooks 2002). *Nothancyla verreauxi* is reported to have gonosetae, but is not coded for them (Winterton and Brooks 2002).

Conclusion.—Our specimen of *L. croesus* exhibits most of the male abdominal and genital characteristics that Brooks and Barnard (1990) used to distinguish the subfamily Apochrysinæ (Table 1). The main exception, one that was previously noted by Winterton and Brooks (2002) for another genus of Apochrysinæ, is the presence of entoprocesses on the gonarcus. Also, all of the male character-states of *L. croesus*, except one (the presence of entoprocesses on the gonarcus), are consistent with Winterton and Brooks' (2002) placement of the genus in the *Joguina* clade.

Our specimen of *L. croesus* has several features that were previously undescribed for any Apochrysinæ: a very weakly sclerotized ninth tergite (that probably is not fused with the ectoprocts); ectoprocts that are connected dorsally via a broad band; a broadly arcuate, well sclerotized gonarcus

bearing a pair of upturned entoprocesses; and a broadly based, tapering arcessus bearing gonosetae. Whether these unique features are typical of the genus *Loyola* is unknown. We hope that males from the other *Loyola* species will become available for comparison.

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